

Designation: D 1006 - 9301

Standard Practice for Conducting Exterior Exposure Tests of Paints on Wood¹

This standard is issued under the fixed designation D 1006; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

- 1.1 This practice deals only with the testing covers procedures to be followed for direct exposure of house paints and trim paints on new, previously unpainted—wood.
- 1.2 This practice describes wood materials to the environment. When originators of a weathering test-procedure that embodies have the principles considered necessary for reliable results. Variations necessitated actual exposure conducted by circumstances may be introduced by agreement provided they do not violate these principles. One procedure embodying a separate agency, the sprecinfic conditions for the explosure of test and control specimens should be clearly defined and mutually agreed upon between all parties.
 - 1.2 The values stated in SI units are to be regarded as the Annex for use by those who find it convenient. standard.
- 1.3 This standard does not purport to address all of the safety problems, concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

- 2.1 ASTM Standards:
- D 358 Specification for Wood to Be Used-As as Panels in Weathering Tests of Coatings²

Current edition approved June 15, 1993. 10, 2001. Published August 1993. 2001. Originally published as D 1006 - 51 T. Last previous edition D 1006 - 923.

¹ This practice is under the jurisdiction of ASTM Committee D-1 D01 on Paints and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.27 on Accelerated Tests for Paingts.



- E 41 Terminology Relating to Conditioning³
- G 7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials³
- G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials³
- G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests³
- 2.2 U.S. Federal Standard:
- TT-W-571b Federal Specification for Wood-Preservative, Recommended Treating Practice⁴

3. Significance and Use

- 3.1 The procedure described Terminology
- 3.1 <u>Definitions—The definitions given</u> in this practice is intended to aid in evaluating the performance of house <u>Terminologies E 41</u> and <u>trim paints applied G 113 are applicable</u> to <u>new, previously unpainted wood.</u>
- 3.2 Since natural environment varies with respect to season, geography, and topography, test results can vary in accordance with location and may not correlate to actual in-service performance (5.1). this practice.

4. Extent of Test Program Significance and Use

- 4.1 The <u>procexdure described in this practice is intended tof aid in evaluating</u> the <u>exterior exposure test program must</u> performance of house and trim paints to new, previously unpainted wood.
- 4.2 The relative durability of paints in outdoor exposures can be governed by very different depending on the breadth location of the conclusions desired. The types exposure because of p differences in solar radiation, time of wetness, temperature, pollutants, and other factors. Therefore, it cannot be tested, the range assumed that results from one exposure in a single location will be useful for determining relative durability in a different location. Exposures in several locations with different climates which represent a broad range of anticipated service conditions are recommended.
- 4.2.1 Because of year-to-year climatological variations, results from a single exposure test cannot be met, also used to predict the types of woods and structures on absolute rate at which the paints a material degrades. Several years of repeat exposures are needed to get an "average" test result for a given location.
- 4.2.2 Solar radiation varies considerably as function of time of year. This can cause large differences in the apparent rate of degradation in many polymers. Comparing results for materials exposed for short periods (less than one year) is not recommended unless materials are im exporsed at the same time in the same location.
- <u>4.3 The Significance and Use section in Practice G 7 addresses many variables</u> to be considered in <u>establishing the exterior</u> exposure <u>program.</u> tests.

5. Location of Test Sites and Exposure Orientations

- 5.1 <u>Test Sites</u>—The climatic conditions of the test sites should be representative of those of the area in which the paints are to be used. The type and rate of failure of a paint film will vary when exposed to different combinations of climatic and atmospheric conditions. For reliable results, exposure sites should be selected that are representative geographically, climatically, and in atmospheric contaminations with those of the locality in which the paint will be used. To obtain conclusions that are valid for paints with national distribution requires exposure at several sites, selected to cover a wide range in climatic conditions. <u>Suggested sites include south Florida</u>, the Great Lakes region, the hot desert southwest, the northeast, and extreme southern Louisiana.
- 5.2 Exposure Orientation—Unless otherwise specified, specimens for testing house paint should be exposed on vertical test fixtures facing both north or south, or both. In comparisons where dirt collection and mildew resistance are not pertinent, north vertical exposures may be omitted. Test fixtures shall be placed in a location so that there is no shadow on any specimen when the sun's angle of elevation is greater than 20°. Specimens can be exposed at north or south orientations or other "exposure angles" in order to focus on the degradation mode desired. Typical exposure angles are as follows:
- 5.2.1 Vertical North (Northern Hemisphere)—Exposure rack is positioned so that the exposed surfaces of specimens are vertical (90°) facing north, away from the equator. This orientation allows for the accelerated growth of biological organisms since the amount of direct sunlight reaching the specimens is reduced or completely eliminated depending on latitude.
- 5.2.2 Vertical South (Northern Hemisphere)—Exposure rack is positioned so that the exposed surfaces of the specimens are vertical (90°) facing south, toward the equator. This orientation allows direct sunlight to reach the specimens and results in degradation commonly associated with ultraviolet exposure.

Note 1—Other Exposure Orientations—If desired, exposures may also be conducted to provide faster results. See Practice G 7 for more information on other exposure options.

5.3 In the case where it is desirable to expose coated panels in a sheltered area, such as under eaves, a suitable test fence with a sheltered or eave arrangement can be used (see Annex A1).

² Annual Book of ASTM Standards, Vol 06.02.

³ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

³ Annual Book of ASTM Standards, Vol 14.04.

⁴ Suggested sites include the Great Lakes region, Florida, extreme southern Louisiana, the southwest region, and northeast region.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.



6. Exposure Positions

- 6.1 PanelsConstruction of Test Fixtures (Exposed Racks)
- 6.1 Test fixtures should be durable and rigid enough to withstand the effects of weather. All materials used for test fixtures shall be either treated wood or noncorrodible metal without surface treatment. Aluminum Alloys 6061T6 or 6063T6 have been found suitable for use in most locations. Properly primed and coated steel is suitable for use in desert areas.
- 6.2 Test Fixture Design—Test racks of several different designs are currently used for the exposure testing-house of paints-and trim paints should be exposed on-vertical test fences facing both south wood. Test racks for the exposure of paints and no trims th. Inat more closely simulate end-use applications, including under eave exposures, are presented fully in Annex A1. Test racks that are commonly us-wed for the exposure of wood siding boards, primarily for the evaluation of mildew growth, dirt-collection accumulation, and mildew resistance color change are not pertinent, north vertical exposures may shown in Fig. 1. These racks can be omitted. There should configured to hold specimens or specimen holders of any convenient width and length. Adjustable racks can be no obstructions close enough used to accommodate specimens of different lengthas. An offset design (notched cutouts) in t-pahe mounting hardware shall be used in order to avoid contamination from specimens mounted above other specimens. Offsets shall be of the sun more than 2 h after sunrise, or 2 h before sunset.
- 6.2 In proper size to accommodate the width of the siding board. Typically, 152-mm (6-in.) or 230-mm (9-in.) size-wd offsets are used. Other sizes are available. An example of an offset mounting hardware is desirable to expose coated panels shown in a sheltered area, such as under eaves, a suitable test fence with a sheltered or eave arrangement can be used (see Annex). Fig. 2.

7. Construction of Test-Fences

- 7.1 Test fences should be durable and rigid enough Specimens
- 7.1 Choose a wood substrate in accordance with Specification D 358. Prior to remain upright use, test lumber and panels shall be stored under such conditions that the action moisture content of prevailing winds and frost throughout the contemplated period of testing.⁵
- 7.2 Lower edges of test panels, when mounted wood will be maintained within the normal range for exterior woodwork in the region in which the tests are conducted. Exposures on test fences, wood substrates should be at least 18 in. (460 mm) above ground level performed on three panels to avoid dampness and mud splash. Backs allow for variations in wood.
- 7.2 For house paints, unless the pattern of painted boards or plywood siding requires some other choice, test panels should be protected against direct exposure to made of one or the weather other of two patterns of siding, namely 127-mm (0.5-in.) or 190-mm (0.75-in.) bevel siding or 25-mm (1-in.) by methods such as, (1) having panels on both sides 152-mm (6-in.) drop siding. A test panel may be subdivided into two or more test areas. A subdivided panel is one complete panel in which multiple paint specimens are applied to sections of the fence, (2) mounting panel. If the panels-on sheathing, (3) closing in the hoppouse paint test are not subdivided, one 914-mm (3-ft) length of 152-mm siding will be acceptable. If the fence, and (4) sealing the back panels are subdivided, each test area shall be a minimum of 152-mm in length.
 - 7.3 For trim paints, the test panel with aluminum paint.
 - 7.3 Fences should may have watertight caps to keep water from getting behind test panels.

8. Selection 25-mm (1-in.) by 102-mm (4-in.) pieces of Woods for Test Panels

8.1 Paint need be tested only lumber at each end (see Annex A1).

⁵ Fisher, R., "Results of Round Robin Studies of Light and Water Exposure Standard Practices," Accelerated and Outdoor Durability Testing of Organic Materials, Official DigestASTM STP 1202, are acceptable. Warren D. Ketola and Doug Grossman, Eds. ASTM, 1993



FIG. 1 Typical Exposure Rack

⁵ Fences, such as presented by W. A. Southard in the May 1959 issue

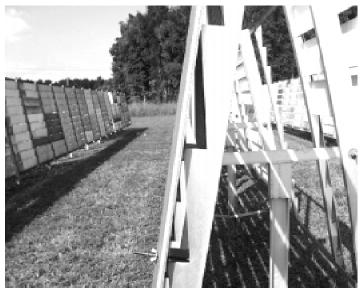


FIG. 2 Offset Mounting Hardware

7.4 For exposures of paints on woods on which it is likely to be used test fixtures described in practice. Conclusions drawn from tests made on 6.2 and Fig. 1, a limited variety of woods, however, test panel should not be generalized for woods a 914-mm (36-in.) length of 152-mm (6-in.) siding substrate unless other-kwise agreed upon. Each area shall be a minimum of 152 mm in length. Each test area can be painted with a different paint thus providing a side-by-side comparison for performance.

Note 1—See Specification D 358.

8.2 Prior 2—It is important to use, test lumber and panels should be stored under such conditions remember that the moisture content up to 75 mm (3 in.) of each end of the wood test will be maintained within masked by the exposure rack.

8. Use of Control orm Reference Materials

8.1 When several paingts are f being comparexd, one paint should be selected as a "control." The control paint should be applied to one ar-wea of each test panel. Variations caused by wood differkences are revealed in the region in which performance of the control paint, and can be used to adjust the ratings of other paints to a common basis. For best results there should be two controls, one known to perform well and one known to perform poorly.

9. Construction Application of Test Panels

- 9.1 For house paints, unless the pattern of the siding requires some other choice, test panels should Paints
- 9.1 All materials being compared in a single study shall be made of one or prepared and exposed within a thirty-day period. For very large studies where all specimens cannot be prepared and exposed within the or thirty-day period, prepare duplicate

coatings of two patterns at least 30 % of siding, namely, or 1 by 6-in. (25 by 150-mm) drop siding.

- 9.2 If prepare and expose specimens of a control paint at the panels in beginning and at the house paint test are not subdivided, one 3-ft (900-mm) length end of 6-in. (150-mm) siding will be acceptable. If the panels are subdivided, two 18-in. (460-mm) lengths are sufficient. Exposures on wood panels should preferably be carried out on three panels to allow period needed for variations completion.
 - 9.2 It is best in theory and practice to do the wood.
 - 9.3 For trim paints, the test panel should carry 1 by 4-in. (25 by 100-mm) pieces of trim lumber at each end.
- 9.4 A test panel of 1.5 ft² (1400 cm²) or more painting outdoors in a proper weather for painting; however, indoor painting is permissible provided in 9.2, may be subdivided into two or no more test areas each not less than 12 in. (300 mm) long one week (72 h is the preferred maximum time) elapses between the successive coats and 0.50 ft² (470 cm²) in area. Each between applying the last coat and exposing on the test area is for fence. Furthermore, all painting must be performed under essentially the same drying conditions. It is necessary to allow each coat to cure sufficiently before top coating.
- 9.3 The preferred procedure is to apply paints with a different paint. Paints placed on the test areas of one panel furnish in a vertical pomsition and kept vertical until the paint has set. If paint is spread on horizontal panels, the panels should be placed vertically immediately thereafter.
 - 9.4 Records should be kept of the spreading rates at which paints are applied. When the purpose of the tests is to behavior.
- 9.5 When compare commercial paints, it will not interfere with may be appropriate to let the painter apply them at their natural spreading rates. When the purpose is to be tested, all panels study variation in the paint composition, application should usually



be coated on the back at suitable predetermined spreading rates that can be controlled by applying a given weight or volume of coating to prevent warping. a measured area.

10. Control or Comparison Paint for ExtendingProcedure

- 10.1 After the Comparisons
- 10.1 When several paints are to be compared, one paint should be selected as panels have been prepared, identify each specimen with a standard of comparison or "control." The control paint should then unique mark that will not be destroyed or become illegible during the exposure. Practice G 147 provides guidance for this phrocedure.
 - 10.2 Measure the desired properties on-one all test and reference control specimens prior to exposure.
- 10.3 Mount the specimens on the correctly oriented exposure rack that accommodates the dimensions of thea specimens being exposed.
- 10.4 Perform the exposure test panel. Variations caused by wood differences are revealed in accordance with the behavior guidelines in Practices G 7 and G 147.
- <u>10.5</u> Select one of the control paint, and can be used to adjust methods for defining the ratings duration of the other paints to a common basis. For best results there should be two controls—one known to perform well and one known to perform poorly. exposure in accordance with Practice G 7.

11. Application of Paints

- 11.1 All tests that are Inspection and Records
- 11.1 After the panels have been exposed to be compared closely with one another the weather, inspections should be placed on exposure as nearly simultaneously as possible. When a group of tests is too extensive for completion within a made after not more than one month, use a control paint or duplicate of at least 5 % three months, and at intervals of three months during the test areas at successive exposure periods.
- 11.2 It is best in theory first two years, and practice to do the painting out-of-doors in proper weather for painting; every six months thereafter. Midwinter inspections, however, indoor painting is permissible provided no may be omitted in northern latitudes. Inspections may be made more than 1 week⁶ elapses between successive coats and between applying frequently if desired. Usually the last coat and exposing on the test fence; and provided, further, that all painting is done under essentially the same drying conditions. It is necessary to allow each coat to cure sufficiently before top coating.
- 11.3 Preferred procedure is to apply paints with the test panel in a vertical position and kept vertical until the paint has set. If paint is spread on horizontal panels, the panels exposures should be placed vertically immediately thereafter.
- 11.4 Records should be kept continued for a considerable length of time after deterioration has reached the spreading rates point at which paints are applied. When the purpose of the tests is to compare commercial paints, it may best practice calls for repainting.
- 11.2 Records should be appropriate to let kept on report forms agreed upon between the painter apply them at what seems to be their natural spreading rates. When purchaser and the purpose is to study variation in paint composition, application should usually be at suitable predetermined spreading rates that can be controlled by applying a given weight or volume of coating to a measured area. seller.

12. InspectionsReport

- 12.1 The report section shall contain the following information when applicable and Records
- 12.1 After panels have been exposed available. In most cases, commercial testing agencies used to perform exposures may not have specific information about the weather, inspections should materials used or preparation of the test specimens and, therefore, cannot be made after not more than 1 month, at 3 months, reported.
 - 12.1.1 Complete description of the test specimens and any control and weathering matervials used, including:
- 12.1.1.1 Composition, including description of 3 months during substrate to which the first 2 years, and every 6 months thereafter. Midwinter inspections, however, may be omitted paint is applied and
 - 12.1.1.2 Method of preparation (reference applicable standards here).
 - 12.1.2 Location of exposure (including whether specimens were exposed at ground level, on a rooftop, and so forth).
 - 12.1.3 Ground cover in-northern latitudes. Inspections may be made more frequently area of test racks.
 - 12.1.4 Angle at which exposure was conducted.
- 12.1.5 Type of exposure (unbacked or backed). If backed exposure is used, include thickness and type of backing and, if desired. Usually painted, the color of paint used.
 - 12.1.6 Date exposure started and date exposure completed.
- 12.1.7 If required, solar radiant energy for all exposures oriented towards the equator including the wavelength bandpass in which radiant energy is measured. All solar radiant energy reported should be continued for measured in accordance with Practice G 7. If required, include a considerable length certificate of time after deterioration has reached the point at which best practice calls calibration for repainting.
 - 12.2 Records should be kept on report forms agreed upon between the purchaser and seller.

13. Report Section

13.1 Complete radiometer used, with this information.



- 12.1.8 If used, details of any specimen treatment such as washing conducted during the inspection report covering the various failure modes agreed upon between the purchaser and the seller. The report shall clearly show a record exposure. Include description of the type treatment used and identification of the product tested, the ratings frequency of treatment.
 - 12.1.9 If required, the various criteria, reference standard(s) used, following climate information:
 - 12.1.9.1 Ambient temperature (daily maximum and other pertinent information.
 - 13.2 The pertinent information covering outdoor weathering tests shall include the following:
 - 13.2.1 Date minimum),
 - 12.1.9.2 Relative humidity (daily maximum and minimum),
 - 12.1.9.3 Total hours of inspection,
 - 13.2.2 Date of exposure start,
 - 13.2.3 Reporting testing facility's order number,
 - 13.2.4 Client's (purchaser's) name, address,
 - 13.2.5 Name of principal contact,
 - 13.2.6 Duration expressed in time,
 - 13.2.7 Radiation data wetness and method used to date measure,
 - 12.1.9.4 Rainfall in centimetrmes, and
- 12.1.9.5 Concentration of MJ/m² of UV, radiation (295nm to 385nm), total solar radiation expressed in MJ/m pollutants such as NO₂, SO₂,
 - 13.2.8 Type of exposure,
 - 13.2.9 Notation as, O₃, and method used to ASTM Test Method used,
 - 13.2.10 Orientation measure the concentration.
- 12.1.10 Results of property measurements if required or conducted before and after exposure. This shall include a description of the samples,
 - 13.2.11 Site location comments section method used to more completely describe measure the f property.

13. Precision and Bias

- 13.1 Precision:
- 13.1.1 Repeatability and reproducibility of res-nults obtained by this practice will vary depending on-panels,
- 13.2.12 Remarks about unusual weather,
- 13.2.13 Other information agreed upon between the purchaser and materials being tested, the seller, and
- 13.2.14 Name material property being measured, the climate in which the exposures are conducted, and year-to-year differences in climate at a single location. Therefore, no specific statement about the absolute precision of the person and signature results obtained by this practice can be made.
- 13.1.2 Comparison of test materials to control materials exposed at the person making same time has been shown to reduce the effects of variability in exposure tests.⁵
- 13.2 Bias—Bias in results obtained in accordance with this practice will vary with the materials being tested, the material property being measured, the climate in which the exposures are conducted, and year-to-year differences in climate at a single location. In addition, no acceptable standard reference materials are available for the myriad of material weathering property responses.

14. Keywords

14.1 durability; exposure tests; exterior; wood and wood products exposure; weathering

ANNEX

(Mandatory Information)

A1. CONSTRUCTION OF TEST FENCE AND TEST PANELS

- A1.1 The plan for test fence and panels described in this—A_annex conforms to the principles set forth in this practice. It represents only one of numerous possible embodiments of the principles recommended.
 - A1.2 Construction of Test Fence:
 - A1.2.1 The test fence, or test rack, runs east and west, and is constructed to hold test panels on both sides so that there are panels facing both north and south. There are two rows of panels, one above the other, on each side of the fence. A 90° cap is placed along the top of the fence, and projects approximately 1 in. (25 mm) beyond the face of the mounted panels. The fence must be sufficiently sturdy in construction to withstand strong winds. It is mounted on wood posts that are impregnated with creosote under

pressure, in accordance with Fed. Spec. TT-W-571b.

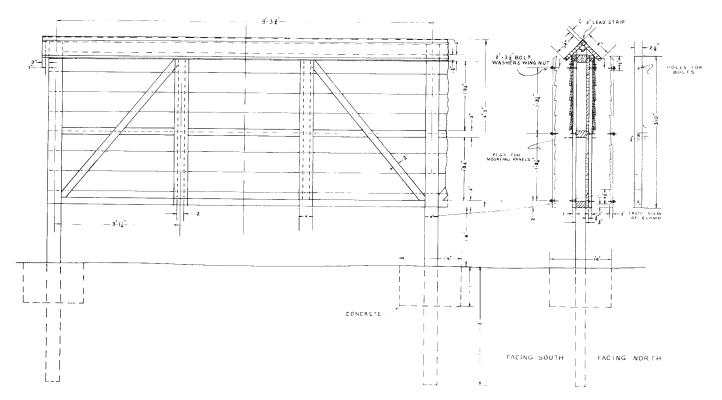
A1.2.2 Fig. A1.1

- A1.2.1 The test fence, or test rack, runs east and west, and is constructed to hold test panels on both sides so that there are panels facing both north and south. There are two rows of panels, one above the other, on each side of the fence. A 90° cap is placed along the top of the fence, and projects approximately 1 in. (25 mm) beyond the face of the mounted panels. The fence must be sufficiently sturdy in construction to withstand strong winds. It is mounted on wood posts that are impregnated with creosote under pressure, in accordance with Fed. Spec. TT-W-571b.
- A1.2.2 Fig. A1.1 shows one span or unit. The fence can be extended to as many units as the site permits or as are needed for the number of exposure tests to be made. Additional fences may be built parallel to one another, but they should be spaced far enough apart to keep each fence from casting shadows on the adjacent fences during all but the first 2 h after sunrise and the last 2 h before sunset at the time of the winter solstice.
- A1.2.3 When cleated panels of drop siding, which do not have backing, are used, there shall always be a pair of panels, one facing north and one facing south, to give the backs mutual protection from the weather. If for any reason there are panels on one side only of the fence, the other side shall be covered with roofing paper or other covering to protect the backs of the panels.

A1.3 Construction of Test Panels:

A1.3.1 *House Paints*—The boards of siding are assembled in a manner similar to house construction. Five pieces of ½ by 6-in. (13 by 150-mm) bevel siding are nailed securely on a backing of ¼-in. (6-mm) plywood exterior grade, as shown in Fig. A1.2. The top board is a blank connecting board, cut to narrower width and painted as hereinafter described. The other four boards are test boards: they may be all of one species or two each of two different species. The overlap between boards should be not less than 1 in. (25 mm). Cadmium- or zinc-coated nails, 1½ in. (28 mm) long, should be used and should be spaced as indicated, and clinched on the back. The lower edge of the bottom board is shimmed out from the plywood with a wood shim and the bottom board projects ¼ in. beyond the shim in order to permit insertion of a panel underneath. The top of the panel, which is a blank board precoated with chalk-resisting exterior paint such as aluminum paint, is cut to a width of 4½ in. (115 mm); the cutting makes a suitable shim for use under the bottom board. The plywood projects ½ in. beyond the boards at the ends and 1 in. (25 mm) at the bottom; at the top the plywood projects 2 in. (50 mm) beyond the top of the second board and is overlapped by about 2½ in. (65 mm) by the top blank board. Holes are bored through the top blank board as indicated to permit positioning of the panel on the fence by means of small pegs. Holes are bored through the projecting ends of the plywood to permit secure fastening of the panels to the fence by means of wood clamps held in position by bolts with wing nuts as indicated (see also Fig. A1.1).

A1.3.1.1 Panels made of 6-in. (150-mm) drop siding should consist of four test boards 37 in. (940 mm) long, and a narrow blank connecting board 3 in. (75 mm) wide, fitted snugly together and held by three cleats, 5% by 2 in. (16 by 50 mm) wide, nailed firmly



Note 1-1 in. = 25.4 mm; 1 ft = 0.3048 m.

FIG. A1.1 ASTM Panel Rack for Exterior Exposure of Paints

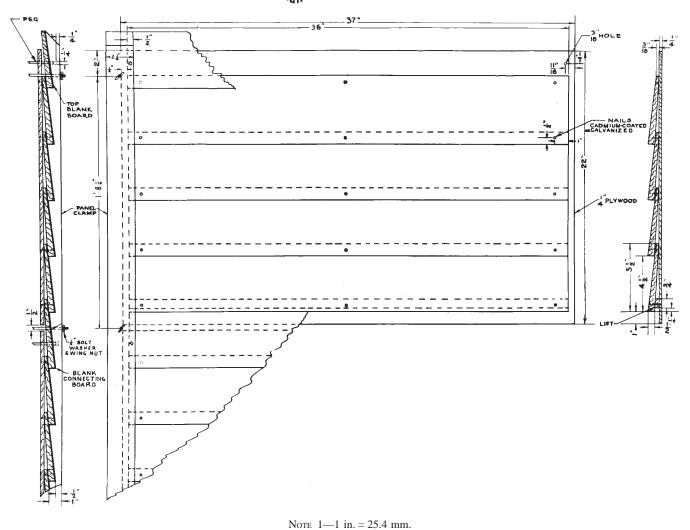
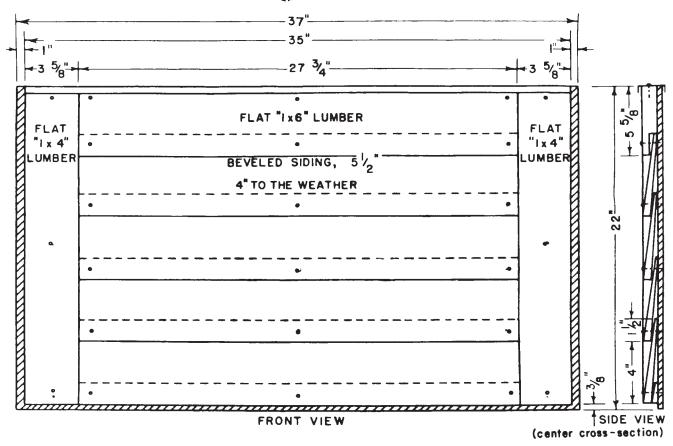


FIG. A1.2 ASTM Clapboard Test Panel for Exterior Exposure of Paints

- on the backs. By adjusting the width of the blank connecting board, the drop siding panels can be made to fit on fences designed as shown in Fig. A1.1, although it may be impracticable to mount both types of panel together on the same fence.
- A1.3.2 *Trim Paints*—An example of a panel for testing trim paint is shown in Fig. A1.3.2. It is a modification of the panel shown in Fig. A1.2. The modification consists in shortening the pieces of siding to 27 in. (685 mm) to make room for two pieces of trim lumber, 1 by 4 in. (25 to 100 mm), at each end; and in narrowing the exposed width of the siding to 4 in. to make room for another piece of trim lumber, 1 by 6 in. (25 by 150 mm), across the top. This piece is undercut, as shown in the sketch, so as to fit over the siding. The cap may be made of galvanized iron, aluminum, or painted iron. No blank connecting boards between two panels are needed. The panel may be fastened to the fence in the same way as the body paint panel. A much less elaborate panel, satisfactory in many cases, is merely a plain board, approximately 1 by 6 by 36 in. (25 by 150 by 915 mm).





 $No{\rm TE}\ 1{\rm --}1\ in. = 25.4\ mm.$ FIG. A1.3 ASTM Test Panel for Exterior Exposure of Trim Paints

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